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Original Article

PREPARATION OF AL6061-SIC- BAGASSE ASH MMCS BY USING STIR CASTING METHOD AND EVALUATION MICROSTRUCTURAL, MECHANICAL PROPERTIES AND NUMERICAL ANALYSIS

S. C. PRASANNA & T. TAMIL SELVAN

M. Kumarasamy College of Engineering, Karur, Tamil Nadu, India

ABSTRACT

Metal Matrix Composites are promising materials for automotive, advanced structural, defense, marine, aviation, and applications, aerospace and other related sectors due to their tremendous combination of properties. The material characteristics of Al6061 with Sic- Bagasse ash MMCs is made by stir casting techniques were studied. Aluminum metal matrix composites are suitable materials for various applications such as marine, automotive (pistons, shaft, bearings), aerospace and structural components because they have lightweight, ductile and have an excellent strength to its weight ratio. The three samples have been fabricated they are Sample1 (Al90%+SiC10%), Sample2 (Al 90%+SiC5%+ Bagasse ash 5%) and Sample3 (Al90% +SiC 3%+ Bagasse ash 7%). The prepared specimen by using stir casting method undergoes various tests like Hardness, impact, tensile and microstructure. It clearly reveals the effect of SiC, Bagasse ash increasing weight fractions of the composite. This present work by adding different fractions of reinforcement to achieve high impact strength, high tensile and hardness strength and SEM test shows the uniform distribution of reinforcement materials.

KEYWORDS: Al6061-Aluminium 6061 Grade, Sic -Silicon Carbide, BAGASSE ASH, Stir Casting Method, Ammcs-Aluminium Metal Matrix Composites

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INTRODUCTION

Metal matrix composites can be used a wide range of industrial applications e.g. aerospace, automobile industries, and manufacturing industries due to necessary characteristics of good corrosion resistance, high thermal conductivity, lightweight metal, high hardness and thermal shock resistance, superior wear, high fatigue strength and so on. These properties of reinforcement matrix materials are productive of the metal matrix composites (MMC's).The advantage of reinforcement to increase the strength of the mixed composite materials MMC's generally made the most of the stir casting method was preferred compared with the other casting methods. It was easy to manufacture, highly flexible during the machining process. In this method, reinforcement is distributed uniformly for the different conventional alloys. During this conventional process, the binding of metal and ceramic is the biggest achievement of composite materials. Development of composite material good bonding between the base material and reinforcement material. Oxidation is difficult to place between the matrix material and reinforcement in order to achieve uniform distribution of powder particles. The size and shape of powder material of reinforcement encountered during the manufacturing of metal matrix composites.

Various properties of reinforcement use different materials as Sic, TiO2, Al2O3, B4T etc. This Tio2 is a new reinforcement in metal matrix composites and has good thermal conductivity, high stiffness, and low weight ratio respectively for the distribution of metal matrix composites. Present work to investigate the effect reinforcement bonding with different percentage ratios in aluminum based composite metal matrix composites. And also using finite element method through tensile and impact test was investigated belongs to under the different loading conditions. The property of tensile, hardness, and impact was investigated in this metal matrix composite.The microstructure was evaluated the binding of three more composite materials as matrix and reinforcement phase.

K. R. Padmavathi et al in this work she tells about Wear and Friction behavior of Al6061 by varying the weight percentage of Silicon Carbide and carbon nanotube through stir casting method. For the prepared specimen wear test was made by using pin-on-Discs wear tester investigation shows that under mild wear condition wear rate has been reduced. However, for cruel wear conditions wear rate has been increased friction and wear behavior of Al–-SiC-MWCNT is largely affected by varying the load [1] Vencl et al in his experiment Al356-reinforced with SiC and Al2O3 by varying the 3 wt. % and keeping constant investigation is been made. The shape of the reinforcement particles with 12 μm in diameter which make the improvement in wear resistance for the composite materials has become important for specific load up to 1 MPa [2]. Sharma et al in his paper he tells about liquid metallurgical technique. A pin on disc wear testing machine is used to carry out tribological tests on both matrix alloy and composite with a load range of 10 to 50N by varying the distance 0.5 to 3km. Al6061 is been reinforced by SiC particles will obtain superior mechanical properties [3]. Hasim.J et al he have noticed that one of most significant in the fabrication of aluminum matrix composite because of their compatibility of reinforcement in the matrix materials. In this case, Al composite is covered with a thin layer of oxide which may block the surface wetting and reacts with ceramic particles. The tribological behavior of aluminum, SiC, graphite hybrid composites with by varying the weight percentage of graphite is prepared by using semi -solid powder method. Since the particle is been filled in MMCs there is no significant variance in the mechanical properties [4].

EXPERIMENTAL SETUP

Al6061 was melted by using crucible heating in a blower furnace at 800°C for 15 minutes. The SiC and Bagasse ash is preheated at 750^{o}C. Initially furnace temperature is been raised above the liquid temperature is about 700^{o}C. Then Al6061 is melted complete and then it made to be cooled down just below the liquid temperature to keep the slurry in the semi-solid state.[5] With the help of drilling machine stirring process is carried out. Stirring is done for about 10 min and the stirring rate is at 450 rpm. At this point, the preheated SiC and Bagasse ash were added manually into the vortex. At the end of the mixing process the furnace temperature is been controlled within 700 ± 10oC. After completing the process, the mixture of the composite material was poured into the cavity and it is made to be cooled at a room temperature. With the same process, all the three samples have been prepared

Compositions of Samples

Table 1: Composition of Three Different Samples

Sample I	Sample II	Sample III
Al6061 90 % - 900gm SiC 10% - 100gm	Al6061 90 % - 900gm SiC 5% - 50gm Bagasse ash 5% - 50gm	Al6061 90 % - 900gm SiC 3% - 30gm Bagasse ash 7% - 70gm

Al 6061

In this study, AA6061 alloy has been selected as matrix alloy since it has high strength, good toughness, and good surface finish, excellent corrosion resistance to atmospheric conditions, good workability and good weldability. The chemical composition and properties of A6061 are shown in Tables II respectively

Table 2: Chemical Composition of AA6061

Elements	Fe	Cu	SiC	Ti	Mg	Mn	V	Al
Weight %	0.17	32	0.63	0.02	1.08	0.52	0.01	Remaining

SILICON CARBIDE (SiC)

By adding SiC as reinforcement material in MMCs various Thermal, wear and mechanical properties are been significantly improved. Silicon carbide is a strong bond in crystal lattices is been composed of silicon atoms and tetrahedral carbon.[6] This produces a very strong and hard material. The physical properties of SiC which have high strength, high hardness, low density, high elastic modulus, low thermal expansion and excellent thermal shock resistance.

BAGASSE ASH

The Bagasse was collected from the sugar factory, then it has taken to drying by sunlight for two to three days. Then Bagasse was fired to make ash content. That ash content was not of uniform particle size. Then it has taken to the screening test. In the screening test, the ash was screened to 90mm. Then the Ash has been collected as much as required [7]

HARDNESS TEST

Bulk hardness measurements were carried out on the composite samples by using standard microhardness test machine. The load applied was 250kg and indenter used was 1\16 inch B scale type.[8] The hardness of the specimen varies because of adding silicon carbide and titanium dioxide. In addition of Silicon carbide and titanium dioxide constituent's similar hardness values at the same time, the addition of 7 Percentage of Silicon carbide and also the 3 percentage addition of Bagasse Ash increase the hardness value to a higher hardness. This is due to the volume fraction reduction in that particular specimen [9].

Table 3: Micro Vickers Hardness Test

Samples	Average Hardness
Sample - I	70.22
Sample - II	74.15
Sample - III	78.61

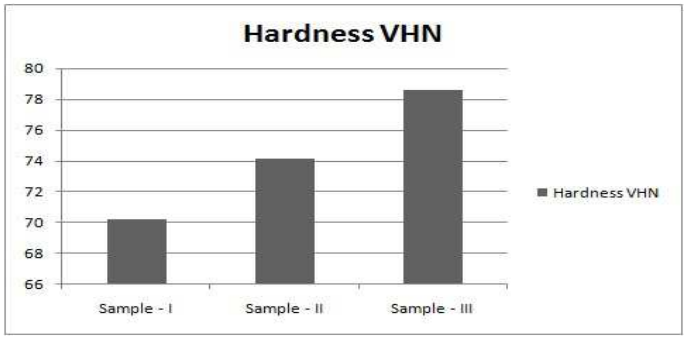

Figure 1: Micro Hardness Test Result

TENSILE TEST

To determine the mechanical properties of the composites materials the tensile test was taken by using Universal Testing Machine. Three different specimens were tested. We attain the stress and strain curves which clearly show the strength of the composition [10]. The tensile properties such as % elongation, yield strength, and tensile strength can be obtained from it. Where the increases in the reinforcement materials which lead to increases in tensile strength

Table 4: Tensile Test Result

Samples	Yield Strength	Ultimate Tensile Strength	Elongation (%)	Reduction in Cross Section (%)
Sample - I	116.2	129.6	1.4	2.1
Sample - II	116.52	132.3	1.7	2.3
Sample - III	117.8	134.5	1.8	2.7

IMPACT TEST

Impact test has been conducted on impact testing machine AIT 300N. T standard impact specimen was prepared. Impact specimen having the dimension of 8x8x55 and corresponding values of impact strength were calculated from the standard formula [11].

The impact strength of the compositions for the graph variation as shown in below the graph. Impact of high energy can withstand for the increasing the reinforcement to desire the strength of the metal matrix composites. The moment increasing torsion for the test specimen toughness of the material under the dynamic loading condition was determined. And the principle of the amount of strain energy will break the test specimen, matrix and reinforcement characteristics were evaluated. This energy variation shows the stiffness of the material.

Table 5: Impact Test

Samples	Impact Strength
Sample - I	55.4
Sample - II	56.3
Sample - III	59.7

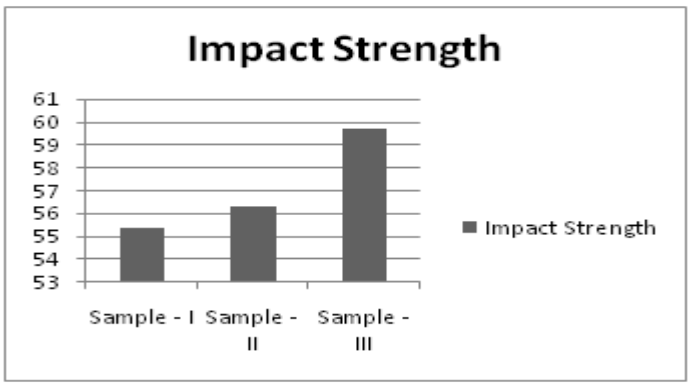

Figure 2: Impact Test Result

MICROSTRUCTURE TEST

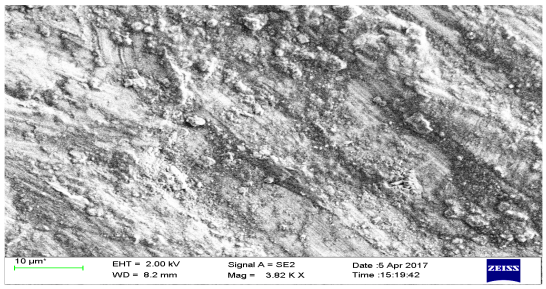

Figure 3: Sample 1 (Al90%+SiC10%),

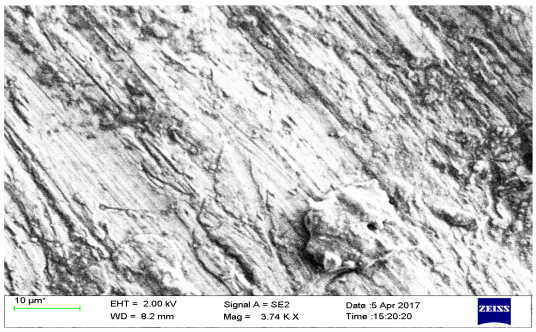

Figure 4: Sample 2 (Al 90%+SiC5%+ Bagasse ash 5%)

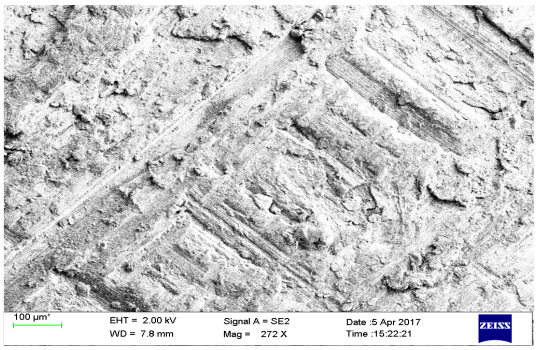

Figure 5: Sample 3 (Al90% +SiC 3%+ Bagasse ash 7%)

CONCLUSIONS

The mechanical, wear properties and microstructure test were conducted with three different samples where Al6061 is reinforced with an SiC and Bagasse ash were fabricated by using stir casting method. The result reveals that the Sample3 (Al90% +SiC 3%+ Bagasse ash 7%) better hardness properties since the reinforcement materials have been made to be increased compare to other two samples. Certainly when the increase of reinforcement also increases the strength of the materials. Impact test was made for all three different sample by among that three sample in which Sample3 (Al90% +SiC 3%+ Bagasse ash 7%) has better wear resistance characters and tremendous co-efficient of the friction SEM test were made by using electron scanning microscope clearly shows the uniform distribution of the materials

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